CHAPTER 9

Wetland Communities

by Steven W. Miller
Division of Resource Management
Department of Natural Resources

Wetland communities vary widely in their plant and animal composition. For example, northern bogs, such as this muskeg and bog along the Black River in Douglas County, are generally acidic and support species adapted to very different conditions than the alkaline marshes of southern Wisconsin. *Photo by Eric Epstein.*

Description

All *wetlands* have a common characteristic—soils or a substrate that is periodically saturated with or covered by water. The statutory definition of a wetland used in Section 23.32 (1), Wisconsin Statutes is "an area where water is at, near, or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions."

People often think of wetlands as cattail marshes utilized by waterfowl and muskrats. However, many other types of wetlands occur in Wisconsin and are given names such as wet meadow, swamp, bog, fen, sedge meadow, shrub-carr, alder thicket, conifer swamp, and bottomland or lowland hardwood forest. Curtis (1959) described wetland communities for Wisconsin and discussed their general characteristics and relative diversity of plant species (Table 9). Wetlands vary in their plant and animal composition and in their diversity. Northern bogs, for example, are generally acidic and support fewer plant and animal species in fewer numbers than the alkaline marshes of southern Wisconsin.

Detailed wetland classification systems have been developed. The earliest, most widely used major classification system for wetlands in the United States was developed by Shaw and Fredine (1956). However, this system was overly simplistic and was replaced with the U.S. Fish and Wildlife Service's *Classification of Wetlands and Deep-Water Habitats of the United States* (Cowardin et. al. 1979). Wisconsin's classification system (Wis. Dep. Nat. Resour. 1992*c*) is based on this system, but incorporates some modifications to make it easier to use and understand. (See Payne 1992 for comparison of wetlands classification systems.)

Wetlands are part of the water cycle of all ecosystems, and their location in the landscape allows them to function as a buffer between upland areas and surface waters (Weller 1981). Wetlands perform a number of natural functions that benefit natural ecosystems and society. Water quality is often dependent upon wetlands because they serve to trap sediment, remove nutrients, protect shorelines, and slow the effects of flood water. They also serve as both discharge and recharge areas for groundwater and provide habitat for

Table 9. Wetland Communities of Wisconsin (from Curtis 1959)

Community	Description	Approximate Original Area
Southern Lowland Forests	Found along river valleys and on lake plains primarily south of theTension Zone; also in depressions on poorly drained moraine; known as bottomland or floodplain forests along rivers and hardwood swamps on lake plains; floodplain forests present along all of the major rivers in southern Wisconsin; hardwood swamps found around the larger existing lakes and also on extinct glacial lakes. American elm was formerly important in all southern lowland forest types.	420,000 in the two types.
Southern Wet Forests	Dominated by boxelder, black willow, cottonwood, silver maple and river birch.	Very small, probably only 20% of total bottomland forest or 84,000 acres.
Southern Wet-Mesic Forests	Dominated by silver maple, green ash, swamp white oak, and hackberry.	Uncertain. Probably 80% of total bottomland or 336,000 acres.
Northern Lowland Forests	Include tamarack-black spruce bog forests, white cedar-balsam fir conifer swamps, and the black ash-yellow birch-hemlock swamps; found on lake beds and along streams north of the Tension Zone.	2,240,000 in the two types.
Northern Wet Forest	Dominated by black spruce and tamarack; white cedar, balsam fir, and jack pine of secondary importance; with an understory of mosses, sedges, and ericaceous shrubs; occurs on acid peat.	Uncertain. Possibly 75% of total northern lowland forest or 1,680,000 acres.
Northern Wet-Mesic Forest	Cedar swamps are dominated by white cedar and balsam fir; with hemlock, yellow birch, and black ash of secondary importance. Hardwood swamps are dominated by black ash with yellow birch birch, red maple, and white cedar.	Uncertain. Possibly 25% of total northern lowland forest or 560,000 acres.
Open Bog	Has a continuous carpet of sphagnum moss; found in pitted outwash or kettle depressions, mostly in northern Wisconsin with a few relicts in southern Wisconsin; dominant families are the Ericaceae and Cyperaceae; bog shrubs include rosemary, leatherleaf, bog laurel, and Labrador tea.	No information. Probably less than 5% of conifer swamps or 110,000 acres.
Alder Thicket	Common along springy areas with mineral or muck soils, along streams, and around lakes north of the Tension Zone; dominated by tag alder.	Unknown.
Shrub-Carr	Common around lakes and ponds and invades sedge meadow south of the Tension Zone; wet-ground community dominated by tall shrubs other than tag alder; dominated by red osier dogwood and willow species.	Unknown.
Sedge Meadow	Open community of wet soils where more than half the dominance is contributed by sedges rather than grasses; found in all regions of the state in extinct lake beds, around the shores and banks of lakes and streams, and in depressions in pitted outwash or moraine topography.	1,115,000 acres in the two types.
Northern	Tussock meadows (dominated by *Carex stricta*) occur statewide and are generally smaller in the north. Wire-leaved sedge meadows are found mostly in northern Wisconsin and can cover thousands of acres.	Uncertain. Probably 105 or 115,00 acres.
Southern	Dominated by *Carex stricta* and bluejoint grass; occur along streams and lakeshores and in morainal lowlands.	Uncertain. Possibly 90% or 1,000,000 acres.
Calcareous Fen	Shrub-herb community on a wet and springy site with an internal flow of alkaline water; found more frequently in southeastern counties.	Very small, probably only a few hundred acres.
Wet Prairie	Grassland on wet soils; located south of the Tension Zone; dominated by bluejoint grass, sloughgrass, big bluestem, and prairie muhly grass.	Uncertain. Possibly 5% of total prairie or 105,000 acres.
Wet-Mesic Prairie	Grassland on seasonally wet soils; located south of the Tension Zone; dominated by big bluestem, bluejoint grass, sloughgrass, and wild rye.	Uncertain. Possibly 20% of total prairie or 420,000 acres.
Emergent Aquatic Communities	Group of wetland communities along the dividing line between true aquatic and true terrestrial communities. Includes deep and shallow marshes. Found along streams and streamside marshes throughout Wisconsin and along lakes in glaciated Wisconsin.	Unknown.

Wetlands are part of the water cycle, and their location in the landscape allows them to function as a buffer between upland areas and surface waters. This ecosystem, which includes pond, ridge, fen, open bog, and upland along Lake Superior, serves as a natural buffer that traps sediments, removes nutrients, and protects the shoreline. *Photo by Cliff Germain.*

many species of plants and animals (Stearns 1978).

Wetlands are interrelated and interspersed among all the other community types described in this report. Many wetlands are forested (e.g., wet forests and wet mesic forests) and must be considered as part of the continuum of northern or southern forest ecosystems. Wetlands are also interspersed among the prairie and oak savanna areas of southern and east-central Wisconsin. The spatial connections between wetlands, lakes, rivers, and streams are obvious to anyone who has spent time in wetland communities.

Unique to wetland communities and aquatic communities are the state and federal laws that govern their use. These are the only community types in Wisconsin for which a body of law regulating use has developed. As discussed later, these laws developed over many decades as these communities suffered continued destruction. The direct positive effects wetlands exert on water and water quality served as the driving force behind the development of these regulations. In contrast, no regulations to protect terrestrial communities from permanent loss and alteration have been developed.

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Status

Past

Wisconsin's topography was shaped largely by glacial activity. As a result, wetland communities were abundant in Wisconsin before Euro-American settlement and occupied an estimated ten million of the state's 35 million acres (see Table 9). This estimate is based on the original government land surveys of the early 1800s and modern soil surveys; it may be a low estimate, since the data used by surveyors in the 1800s were based on a wetland definition that is conservative compared to our current definitions and because few soils have been mapped in northwestern Wisconsin (Wis. Dep. Nat. Resour. 1990).

In the Driftless Area of the state, which was not affected by the most recent glaciation, forested and nonforested wetlands existed primarily along streams and rivers or as spring seeps. In other regions of the state, wetlands occurred on vast areas of peat soils occupying former glacial lake beds, as potholes and fens; along streams and rivers; on the borders of lakes; as bogs, forested swamps, and bottomlands; and as estuaries and coastal wetlands along Lake Michigan and Lake Superior.

Wetlands have been subjected to intense modification and use and have greatly decreased in number since Euro-American settlement. Nearly all remaining wetlands have suffered from the effects of simplification and fragmentation. From the beginning of Euro-American settlement in the early 1800s until relatively recently, wetlands were viewed as wastelands and were given economic value only when drained or filled (McCormick 1978). The 1850 Federal Swamp Land Act officially set national policy as one of wholesale wetland

"reclamation." In Wisconsin, wetland loss was also accelerated by the 1925 Wisconsin Drainage Law (Kabat 1972).

Historically, the greatest threat to wetlands in Wisconsin has been from agricultural drainage and urban development. Nationally, more than 87% of wetland losses have been due to agricultural development (Tiner 1984). Since wetlands often occur along rivers and lakes, these sites have also been considered to be of particular value for port facilities, for industrial development that required access to water for transport, for industrial processing or cooling water, for the discharge of wastes, for marinas, for residential developments with access to water, and for deposition of dredge materials during construction of channels and wharf facilities (McCormick 1978).

Many thousands of acres of wetlands were eliminated by shoreline development for homes, resorts, and commercial and industrial development. As many of Wisconsin's larger cities expanded, forested wetlands and the marshy estuaries of rivers were cleared and filled to accommodate development. For example, most of the industrial areas in Milwaukee, Superior, and Green Bay are built on fill deposited in coastal wetlands. Portage, La Crosse, and Prairie du Chien are Wisconsin cities built partly on riverine wetlands (Visser 1982).

Historically, some appreciation for unaltered wetlands began to appear in the 1930s, although drainage and filling continued to be promoted by federal and state policies. During that period, concern for wetlands was prompted in part by the catastrophic decline in North American waterfowl populations during the droughts of the 1930s (Kabat 1972). Nevertheless, an era of intensified agriculture began following World War II, which included heavy applications of fertilizers and pesticides, increasingly mechanized agriculture, and continued wetland clearing and draining, subsidized by federal programs and tax incentives. However, beginning in the late 1940s, with continued momentum into the 1970s, wetlands achieved ever-wider recognition as valuable natural resources. Increasingly, land-use plans recommended various levels of wetland preservation; acquisition of wetlands for both state and national waterfowl management steadily increased; and new research began to show the relationship between wetlands, water quality, economically important fish and wildlife species, and the preservation of rare plant and animal species (Kabat 1972, McCormick 1978, Visser 1982).

Wetlands are interrelated and interspersed among all other community types. Many wetlands are forested and are part of the continuum of northern and southern forest ecosystems, as shown here by the concentric bands of open bog, forested bog, and forested upland in Washburn County. Wetlands are also interspersed among the prairie and oak savanna areas of the state. *Photo by Robin Moran.*

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Gradually, as the ecological values of wetlands were recognized, changes began to occur in federal and state policies towards wetlands. The former view that wetlands were just wastelands and impediments to progress was replaced by a recognition that wetlands are critical components of healthy functioning ecosystems with significant direct and indirect economic benefits.

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The oldest of federal laws used to protect wetlands is the River and Harbor Act of 1899, which prohibited the excavation or deposition of material into any navigable water of the United States without a permit from the U.S. Army Corp of Engineers. Although this act had the

potential for major wetland protection, it was administered in a manner that greatly limited its effectiveness (McCormick 1978). The National Environmental Policy Act of 1969 required that many wetland drainage and filling projects be reviewed for their impact on the human environment, particularly if federal agencies or federal money was involved. The Federal Water Pollution Control Act of 1972 required permits for the disposal of dredge material and the filling of waters of the state, including wetlands. The Federal Endangered Species Act of 1973 called attention to the need to protect and restore wetland habitats for endangered plant and animal species.

The 1985 and 1990 Federal Farm Bills contained milestone provisions for protecting wetlands by imposing penalties for converting wetlands to agricultural uses, thus ending the federal agricultural subsidy for wetland drainage. These restrictions, which are known as the "Swampbuster" provisions, helped to stem the rate of wetland conversion to agricultural uses. The 1990 Farm Bill also contained a wetland reserve program which allows the U.S. Department of Agriculture to take permanent wetland easements on restored wetlands on private lands.

Paralleling wetland protection actions on the federal level during this time period, a number of legislative actions occurred in Wisconsin to strengthen state authority to protect wetlands. Prior to the 1960s, the state's role consisted of buying wildlife habitat, fish spawning grounds, and public hunting areas. The state also had authority under Chapter 30 of the Wisconsin Statutes Navigable Water Law to control filling on the beds of navigable waters (Visser 1982).

Established in 1966, Section 144.025 of the Wisconsin Statutes required the Department to protect the waters of the state, including wetlands. In the same year, Section 59.971 of the Wisconsin Statutes required counties to adopt shoreland zoning ordinances for unincorporated areas within 1,000 feet of lakes and flowages and within 300 feet of navigable streams. Rules for implementing s.59.971 were promulgated in NR 115 Wisconsin Administrative Code. (Further references to the Wisconsin Administrative Code will be shortened to "NR.") In 1979, the Wisconsin Legislature approved a statewide wetland inventory program, but the program had no concurrent protection authority. In 1980, the Natural Resources Board adopted NR 1.95, which required Department personnel to consider the effect on wetlands when granting permits and to minimize wetland damage in the permitting process. Also in 1979, NR 115 was amended to require counties to protect wetlands within 1,000 feet of lakes and within 300 feet of streams. An analogous rule, NR 117, was approved to protect wetlands occurring within cities and villages. NR 115 and 117 prohibit wetland alteration without first obtaining a rezoning approval from the county, city, or village. The Department can veto a rezoning approval if the local government fails to consider significant environmental factors in granting the rezoning (Dawson 1982, Visser 1982).

The most recent wetland protection law in Wisconsin is NR 103, which establishes state water quality standards for wetlands. These narrative standards are applied to all Department activities that affect wetlands. They are also applied to federal permits through the state's water-quality certification process under the Clean Water Act.

During the era of the most intensive wetland loss and modification, wildlife and other natural resource values associated with wetlands were recognized only in passing. As a result, along with the loss of wetland acreage, there was a concomitant loss in the numbers of species dependent on wetlands, including waterfowl, shorebirds, herptiles, fish, invertebrates, and many species of plants. There was also a loss of the ecosystem services performed by wetlands, including floodwater storage, sediment and contaminant filtering, and groundwater discharge and recharge.

The species richness of many wetland types prior to Euro-American settlement does not appear to be well-documented. There are, however, indications from

historical observers that many marshes attracted large numbers of migrating waterfowl, were important for fish spawning, and produced large amounts of useful products such as lumber, sphagnum moss, wild rice, and marsh hay (Curtis 1959).

Present

At present, Wisconsin has lost 47% of its original ten million acres of wetlands. Many of the remaining 5.3 million acres are in the northern third of the state (Wis. Dep. Nat. Resour. 1990). In some southern Wisconsin counties, the amount of wetland loss is well over 75%. Wisconsin's losses are reflective of the national status of wetlands; it is estimated that one-half of the nation's original 221 million acres of wetlands have been lost (Feierabend 1992). A large amount of remaining acreage in Wisconsin exists in a partly altered state, such as with old drainage ditches still functional enough to change the hydrology of the wetland. Much of this remaining wetland acreage was at one time disturbed, either by drainage (followed by restoration) or by being cleared, repeatedly burned, grazed, or periodically plowed (Curtis 1959).

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Although there is considerably less drainage of wetlands today due to the "Swampbuster" requirements of the 1985 Farm Bill, agriculture still affects wetlands through grazing, barnyard and feedlot runoff, pesticide and fertilizer runoff, and sedimentation from nonpoint sources. Sedimentation of wetlands leads to the gradual loss of open-water areas and development of monotypic stands of vegetation that have less habitat value to wildlife.

Currently, the collective use of Section 404 of the Clean Water Act, the "Swampbuster" provisions, NR 115, NR 117, and NR 103 have controlled major wetland losses in Wisconsin (Dale Simon, Wis. Dep. Nat. Resour., pers. comm.). The Department plays the lead role in preventing wetland loss through an aggressive regulatory program involving local, federal, and state governments. In addition, there are a number of incentive programs, many rather recent in origin, that are designed to restore or enhance wetlands.

Many wetlands have been lost to agricultural drainage, urban development, and industrial development. Channelization of streams, like this one in the central sands region, was used to drain land and resulted in a simplified and less diverse stream system. *Photo by Michael J. Mossman.*

One newer program involves the U.S. Department of Agriculture Farmers Home Administration (FmHA). As part of the 1985 Farm Bill, FmHA was given the authority to place restrictive-use wetland easements on properties they offer for sale after foreclosure. These wetland easements are then enforced by the U.S. Fish and Wildlife Service. FmHA can also allow borrowers to reduce their debt by granting an easement to the Fish and Wildlife Service. Under the 1990 Farm Bill, the U.S. Department of Agriculture was authorized to take permanent wetland easements. However, Congress funded the program in 1992 only, so its effects have been very limited. Additional wetland protection opportunities occur in other federal laws such as the Coastal Zone Management Act of 1972 and the Fish and Wildlife Coordination Act.

Overall, these state and federal regulatory programs have the capability to substantially reduce wetland losses in Wisconsin. However, contained in these regulations are some exemptions for agriculture, forestry, and various types of

commercial navigation activities. These exemptions have been criticized by ecologists and wetland protection advocates as being unnecessary, and efforts continue to bring all activities affecting wetlands under regulatory review.

In addition to protecting wetlands through regulations, the Department and the U.S. Fish and Wildlife Service have a commendable record of acquiring wetlands for wildlife and fishery management, natural areas, and other purposes in the state. Between the U.S. Fish and Wildlife Service, the Department, and nonprofit conservation organizations, hundreds of thousands of acres of wetlands have been acquired, and many thousands of acres of drained wetlands have been restored. Notable large wetland acquisition and restoration projects are Horicon Marsh National Wildlife Refuge, the Glacial Lake Grantsburg Wildlife Area Complex, Necedah National Wildlife Refuge, Mead Wildlife Area, Meadow Valley Wildlife Area, Green Bay West Shores Wildlife Area, the Upper Mississippi National Wildlife Refuge, and the Mink River Estuary. Additionally, many thousands of acres of small wetlands and associated uplands have been purchased. Much of this acquisition was focused on waterfowl and fishery management, but significant benefits are provided to other wetland-dependent species such as sandhill cranes and other wading birds, furbearers, herptiles, and plants. A number of private organizations have also protected large areas of wetlands.

Many thousands of acres of small wetlands and associated uplands are in state and federal ownership. Much of this acquisition was focused on waterfowl and fishery management, but significant benefits are provided to other wetland-dependent species such as sandhill cranes and other wading birds, furbearers, herptiles, and plants.

Wetland management practices conducted to improve waterfowl habitat have impacted wetlands in the state. The principles and techniques used and their implications are discussed by Weller (1978, 1981) and Payne (1992). In most cases, these activities have restored large areas of wetlands that had been drained for agriculture. Many of the drained wetlands were originally sedge meadows, shrub-carr, tamarack swamps, and wet prairie; however, shallow lakes were also drained. Restorations for waterfowl habitat often resulted in shallow and deep-water marshes that may not have been the condition of the wetland before it was drained. Some habitat improvement projects also purposefully converted sedge meadows, shrub-carr, and wet prairie into shallow and deep-water marshes under the justification that these wetlands were being enhanced for waterfowl and wildlife. The result has been that wildlife and plant species needing shallow and deep-water marshes have greatly benefited, while species that preferred the pre-existing wetland type suffered some habitat reduction. From a statewide perspective, however, the areas of wetland affected by wildlife management activities are a small portion of the total wetland modification or loss that occurred due to agriculture and urban development. The net effect of wildlife management wetland restoration and enhancement projects on biodiversity appears to be positive. Current wildlife management of wetlands focuses on restoring many of the original shallow and deep-water marshes that were drained for agriculture.

On both national and state levels, renewed emphasis was placed on the value of wetlands for waterfowl and other aquatic wildlife with the implementation of the North American Waterfowl Management Plan beginning in 1986 (U.S. Fish and Wildl. Serv. 1986). This program, signed by Canada and the United States, encourages public-private partnerships in protecting and restoring wetland habitats. The plan is continental in scope, recognizing that many species of birds associated with wetlands

need secure habitats across the entire North American continent. Wisconsin is a direct participant in this effort through the Upper Mississippi River and Great Lakes Region Joint Venture (Wis. Dep. Nat. Resour. 1992*a*)

The Wisconsin Wetland Inventory (Visser 1982, Wis. Dep. Nat. Resour. 1992*c*), authorized by the Legislature in 1979, was initially completed for all counties in 1984. Wetlands two acres or larger in size are delineated and classified on 1:24,000-scale maps. These inventory maps were supposed to be updated every ten years, but limited funding has slowed the process to a 20-year cycle (Dale Simon, Wis. Dep. Nat. Resour., pers. comm.).

Wetlands are noted for their abundance of plant and animal life. Of Wisconsin's 370 species of birds, 39% live in or use wetlands. According to Hale (1982), no other Wisconsin habitat type comes close to this avian occupancy rate. Hale also commented that although no wetland bird species has been extirpated from Wisconsin due to wetland destruction, the significant loss of wetland acreage has to have caused a decline in wetland-dependent birds.

Many important game birds, mammals, and fish are associated with wetlands. Waterfowl, beaver, muskrats, and northern pike are obvious examples. However, other species are also significantly related to wetlands. In some river systems, such as the Wolf River, walleye use seasonally flooded wetlands for spawning. Ring-necked pheasants use shrub-carr and cattail marshes during the winter. White-tailed deer thrive in wetland areas composed of shrubs and trees.

Vogt (1981) identified southern lowland forests as "exceptionally rich" and aquatic communities (including open-water marshes) as "extremely rich" in herptiles, as compared with other community types in Wisconsin. Since many herptiles are associated with wetlands, these species have suffered from the loss of wetlands.

Wetlands provide habitat for many species. This forested bog in Douglas County supports breeding pairs of at least sixteen species of warblers. *Photo from Department of Natural Resources files.*

43% of all federally listed threatened and endangered species use wetlands at some point in their life cycle. 32% of the state's threatened and endangered plants and animals are wetland-dependent.

Currently, 43% of all federally listed threatened and endangered species use wetlands at some point in their life cycle (Feierabend 1992); for Wisconsin, 32% of the state's threatened and endangered plants

The prairie white-fringed orchid (*Platanthera leucophaea*), a showy state endangered and federally threatened species, occurs in wetlands in the southern part of Wisconsin. *Photo by Thomas A. Meyer.*

The hardwood swamp has recently been identified as a discrete community in Wisconsin. The ash swamp, including the Ashland County site pictured here, is very wet and is dominated by black ash and alder with mineral rich groundwater. *Photo by Eric Epstein.*

and animals are wetland dependent (Charles Pils, Wis. Dep. Nat. Resour., pers. comm.). Tables 10 and 11 show the wetland species currently on Wisconsin's endangered and threatened species lists.

Considering the vast acreage of northern and southern wetlands that have been drained, cleared, intensively grazed, repeatedly burned, plowed, flooded to create recreational lakes, or filled, it is possible to appreciate how local populations of species became disjunct from one another and eventually extirpated because they could not adapt to the changes in plant succession or were unable to withstand the changes in their microclimates. Migratory species and more mobile species probably suffered less than those with limited or no mobility. The preservation of wetland species that are essentially immobile is dependent upon land protection programs such as state, federal, and private acquisition or cooperative programs with private landowners. Currently, Wisconsin has an aggressive program of identifying and protecting lands with high natural-area value using the Natural Heritage Inventory. The highest ranking examples of all wetland types are considered priorities for permanent protection in the Department's Natural Areas program.

Projected

The enforcement of existing wetland-use regulations should prevent further major loss of wetlands in Wisconsin. It is not possible for every remaining acre of wetland to be preserved. In our society, some wetland loss will be unavoidable, but rigorous planning and analysis of alternatives should help to minimize losses and avoid negative impacts from the perspective of concern for biodiversity. A major threat would result if the federal government changed its definition of wetlands, thus eliminating protection under Section 404 of the Clean Water Act for millions of acres of wetlands (Wis. Dep. Nat. Resour. 1992*b*). This definition is a major issue in the upcoming reauthorization of the Clean Water Act in 1995.

Table 10

Endangered and threatened wetland animal species.

Herptiles		Birds		Lepidopterans	
Endangered	**Threatened**	**Endangered**	**Threatened**	**Endangered**	**Threatened**
Blanchard's cricket frog	Blanding's turtle	yellow-throated warbler	red-shouldered hawk	Powesheik skipper butterfly	swamp metalmark butterfly
massausauga rattlesnake	wood turtle	trumpeter swan	cerulean warbler	silphium borer moth	
western ribbon snake		Caspian tern	hooded warbler		
northern ribbon snake		Forster's tern	yellow-crowned heron		
queen snake		common tern	great egret		
			red-necked grebe		

Existing state, federal, and private wetland acquisition and easement programs will continue for the foreseeable future. There are also plans covering the Mississippi River (U.S. Army Corps Eng. 1991) and the Lake Winnebago Pool Lakes (Wis. Dep. Nat. Resour. 1989) to enhance wetland areas that have been severely degraded. The recent surge of effort to restore wetlands on private lands enrolled in the Conservation Reserve Program will continue as long as the program continues. This work could be considerably enhanced if the U.S. Congress and Department of Agriculture would commit to long-term funding of the Wetland Reserve Program; to date, Congress provided funding for 1992 only.

Watershed-based, nonpoint pollution control programs will continue to expand. These activities will afford major opportunities to work with private landowners to achieve water quality benefits and wetland preservation and restoration goals. In many watersheds, restoring wetlands will be a major technique for achieving nonpoint pollution objectives.

A continuing driving force behind wetland acquisition, management, and protection in Wisconsin will be the desire to enhance hunting and fishing opportunities. Organizations such as Ducks Unlimited, Wisconsin Waterfowl Association, Trout Unlimited, The Nature Conservancy, the Wisconsin Wildlife Federation, the Conservation Congress, and others will continue to be very active in assuring that state policies protect wetlands. These groups now are also working with other conservation groups to integrate their specific interests with broader goals for water quality, nongame wildlife, soil erosion control, and aesthetics, all of which contribute to the protection of biodiversity.

If all of these programs and efforts are continued, wetland acreage in Wisconsin could increase somewhat; at least many wetland areas not being farmed or otherwise drained will be restored. These efforts will also result in better protection of undisturbed wetlands and improved management. The cumulative result should be a better assurance that the biodiversity of wetlands statewide will be protected and enhanced wherever possible. Since wetlands are so interspersed among the other major community types in the state, the biodiversity benefits of protecting, restoring, and enhancing wetlands will contrib-

Since wetlands are so interspersed among the other major community types in the state, the benefits of protecting, restoring, and enhancing wetlands will contribute to the ecological health of these communities, also.

Table 11

Endangered and threatened wetland plant species.

Endangered	Threatened
auricled twayblade	beaked spike rush
angle-stemmed spikerush	false asphodel
prairie white-fringed orchid	English sundew
netted nut-rush	lenticular sedge
floating marsh marigold	coast sedge
hop-like sedge	Michaux's sedge
chestnut sedge	bald rush
bog rush	calypso orchid
pink milkwort	round-fruited St. John's wort
tussock bulrush	bog bluegrass
lake cress	white lady's slipper
alpine milk vetch	marsh valerian
crow-spur sedge	linear leaved sundew
brook grass	marsh grass-of-parnassus
hemlock-parsley	ramshead lady-slipper orchid
beak grass	small round-leaved orchid
chestnut sedge	Garber's sedge
umbrella sedge	sweet coltsfoot
Fassett's locoweed	algal-leaved pondweed
heart-leaved plantain	sheathed pondweed
seaside crowfoot	
small yellow water crowfoot	

ute to the ecological health of these communities, also.

Actions Causing Concern

Although the era of large-scale, federally subsidized wetland drainage and filling has been assumed to be over, changes in federal policy could dramatically alter the current condition. Nationally, wetlands are afforded major protection due to the provisions of sections 404 and 401 of the Clean Water Act and the 1985 and 1990 Farm Bills. These provisions were recently under serious threat by attempts to redefine what a wetland is in the federal manual for identifying and delineating wetlands (Wis. Dep. Nat. Resour. 1992*b*). The proposed changes would have more narrowly defined wetlands, and the impact would be highly significant. In Wisconsin, for instance, under the proposed *1991 Wetland Delineation Manual*, as much as 80% of the state's wetlands would not fall under the new definition and thus not be afforded the protection they now have (Dale Simon, Wis. Dep. Nat. Resour., pers. comm.).

In coming years, wetland-filling will continue to be an increasing threat to wetland areas, as pressures for nonagricultural land use become more intense. Shoreline development on inland lakes is continuing but is subject to county regulation. Since most of the best lakeshore properties have already been developed, those that remain are less desirable; sometimes these are wetland areas that the owner wants to fill for development. The loss of these wetlands would have negative implications for water quality and wetland species habitat. Application of existing regulations will be required to prevent negative impacts.

Highway construction also continues to affect wetlands. Wetlands often cannot be avoided during highway corridor selection due to concerns for human safety, farm operations, industry, and historical use patterns. Thus competing public purposes—i.e., wetlands protection and highway safety—lead to compromises to mitigate wetland losses. While the goal is to achieve no-net-loss of wetlands, it is very difficult to replace all the functions and values of wetlands that are lost to highway development, particularly in the immediate area of the loss.

Harvesting of forest products can affect forested wetlands, mainly through changes in the microclimate when overstory trees are removed and soil is compacted by equipment.

Wetlands will continue to be affected by agriculture through grazing, barnyard and feedlot runoff, pesticide and fertilizer runoff, sedimentation from nonpoint sources, and drainage. Landowners not participating in federal commodity support programs may still drain wetlands. Cranberry operations have the potential to affect wetlands by converting existing wetlands to cranberry beds, through the application of pesticides and through the development of water storage reservoirs.

Agriculture in the United States and the world is undergoing major change. Free trade agreements, the changes in Eastern Europe, the demise of the Soviet Union, and the national deficit all affect U.S. agricultural trends. If remaining wetlands are to be preserved, it will be necessary to incorporate their protection into sustainable-agricultural policies that recognize the need to be sensitive to ecological values while producing the food, fiber, and other products needed by society. In the U.S., the Clean Water Act and the Farm Bill are due for reauthorization in 1995. Wetland-agricultural issues will be major considerations in both acts.

The invasion of wetlands by exotic plant and animal species is a significant problem. For example, reed canary grass has been an extremely aggressive invader of sedge meadows. It has significantly displaced native species on many thousands of acres of sedge meadows and shrub carr in the southern parts of the state. When this plant dominates a site, other species are excluded and the community becomes highly simplified. Controlling reed canary grass is very difficult and expensive.

Similarly, purple loosestrife is rapidly invading many wetlands throughout the state. It is an exotic species, first released in this country by nurseries and gardeners, and it crowds out native species. Control of this plant is very difficult, labor-intensive, costly, and controversial, since herbicides may be necessary (Payne 1992). Research has been conducted on importing weevil species from their original habitats in Europe as a biological control; results show promise. So far a dozen states have released weevils for loosestrife control. Wisconsin did its first release in 1994.

Common carp, another exotic species imported from Europe, has had serious negative effects on many wetlands associated with lakes and rivers. During feeding, carp root out aquatic plants, causing turbidity that prevents the regrowth of plants and greatly reducing aquatic invertebrate diversity and abundance. Wetlands with high carp populations have noticeably less abundant wildlife populations than similar types of wetlands without carp. Control is difficult; the best that may occur would be periodic population reductions using intensive harvesting or chemical treatment (Payne 1992). The aquatic plant and wildlife response following a major reduction in carp populations in a wetland is very dramatic.

The lack of fire in some wetland communities results in gradual invasion of woody shrubs and trees, eventually leading to a change in the wetland type. This is most significant for sedge meadows, fens, and shrub-carrs (Curtis 1959). As sedge meadows and other seasonally flooded wetlands convert to dense shrub and forested wetlands, the wildlife species needing open, herbaceous habitat are replaced by those preferring forest and dense shrubs. In Wisconsin prior to Euro-American settlement, this condition was dynamic. During drought periods, wetlands often burned—which set back succession—and often "peated in," creating shallow open-water depressions. Many wetlands that have had their hydrology permanently disrupted by drainage systems are now generally drier than they were originally, which favors shrub and tree growth over herbaceous vegetation. Restoring fire as a natural process in wetland communities can be highly beneficial (Payne 1992).

Beaver can have major effects on wetlands. From a positive standpoint they can help maintain water levels and set back succession into herbaceous wetlands. On the negative side, their dam building activity can severely affect communities such as fens and bogs when associated plant and animal life is replaced by persistent high water levels. In recent years high beaver populations in many parts of Wisconsin have undoubtedly had a wide variety of effects on wetland communities. The long-range effect of elevated beaver populations on wetland community biodiversity is unknown even though local effects may appear quite severe.

Many wetlands are dependent upon seasonal flooding. Elimination of this water

This Wisconsin River floodplain forest is dominated by silver maple. Many wetland communities, including this southern wet-mesic forest, are dependent upon seasonal flooding. Elimination of this water recharge can change the character of a wetland over time. *Photo by William Tans.*

recharge can drastically change the character of a wetland over time. Drought cycles can be beneficial to wetlands through enhanced recycling of nutrients (Sloey et al. 1978), but prolonged drought can result in substantial vegetational changes. For example, cattail and shrub invasion during dry periods can be so dense as to exclude wetland species that require a major open-water component (van der Valk and Davis 1978, Weller 1981). During drought periods many wetlands can also be farmed, resulting in disturbance from cropping or grazing. During the period prior to Euro-American settlement, buffalo and, perhaps, herds of elk had significant impacts on wetland vegetation in some parts of the state. Grazing and trampling probably helped maintain a herbaceous cover. However, this use was seasonal and temporary, unlike the continuous grazing and trampling by domestic livestock that occurs today in some wetlands. Thus controlled, periodic grazing can be used to maintain some types of wetlands (Payne 1992).

Socio-Economic Issues

The role of wetlands as essential components in the healthy functioning of ecosystems has gained broad recognition in the last 20 years. Because so much wetland acreage has already been lost, many regulatory programs have been developed to protect remaining wetlands for the myriad of values they provide to society. While their value for wildlife and plant life has been most promoted, there is ever-growing awareness among ecologists and land-use planners that protecting wetlands for their flood storage, sediment and nutrient filtering, and groundwater recharge/discharge capabilities provides services to our human communities that cannot be simply duplicated with engineered facilities (Stearns 1978, Weller 1981). Thus, in the future there will be more land-use planning that avoids impacting existing wetlands and more proposals that call for the restoration of wetlands where possible. It appears we may be at the beginning of an era of major wetland restoration because of the growing public recognition of wetland values to society and the economy.

Despite this trend towards greater protection, wetlands will continue to be affected by agriculture, highway construction, commercial navigation, and urban/suburban development. In our society, it is probably not realistic to assume every remaining acre of wetland can or should be preserved. However, enough is now known about wetlands, their values, and their functions that any proposed permanent loss must be very carefully considered.

Wetlands are also important for recreation, aesthetics, and education. They provide open spaces in landscapes that are becoming increasingly rare as development continues. Hunters and anglers use them for recreational pursuits. They can be used seasonally for canoeing, hiking, and cross-country skiing. Viewing and listening to wildlife are also popular wetland activities. The bird life in wetlands is often particularly easy to observe, making wetlands favorite bird-watching and photography areas.

Potential for Community Restoration

In assessing the potential for and possible effects of restoring wetlands, the specific characteristics of the types of wetlands and the types of disturbance involved must be considered. Most permanently lost wetlands are those that have been filled or excavated. Some disturbed wetland communities will readily respond to protection, restoration, and management techniques but others may need many decades to return to a pre-altered state. Because wetland communities differ, some thrive with periodic disturbance while others need long-term stability. Wetlands drained for agriculture often quickly respond to restoration efforts, since seed banks can lie dormant for many years (even decades) waiting for the right conditions to flourish (Weller 1981). Many wildlife species will re-inhabit wetlands within a

few years, some within days or months. Once drainage has been stopped, the hydrological functions of a wetland may return somewhat to pre-drained conditions. The ability for drained and partially drained wetlands to be restored to an ecologically functional level allows decisions to be made regarding how much wetland acreage should be restored and where. Since much wetland loss has been due to agriculture, it is highly feasible to design wetland restoration programs that fully integrate with water-quality and sustainable-agriculture programs.

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Possible Actions

The following possible actions are consistent with ecosystem management, but require more analysis and discussion. How priorities are set within this list will be based on ecoregion goals, staff workload, fiscal resources, public input and support, and legal authority. We will work with our customers and clients to set priorities and bring recommendations to the Natural Resources Board for consideration beginning in the 1995-97 biennium.

1. Federal legislation and programs encouraging wetland protection and restoration need to be supported. U.S. Department of Agriculture policies linking participation in commodity support programs to wetland protection need to be continued and enforced. For example, the Conservation Reserve Program and the Wetland Reserve Program will need to be reauthorized in the 1995 Farm Bill. The Clean Water Act Sections 401 and 404 are also due for reauthorization in 1995. Attempts to define wetlands politically rather than scientifically should be opposed.

2. The effectiveness of existing federal, state, and local regulatory programs needs to be continually evaluated. The protection of existing wetlands and the restoration of wetlands depends upon the combined efforts and support of many levels of government interacting with agricultural, business, industrial, and other interests. Good communication and the creation of shared goals and values is essential to prevent attempts at weakening regulations to serve special interests.

3. State, federal, and local land acquisition of wetlands needs to occur in an ecoregion context. Wetland complexes, rather than individual wetlands, have been and should continue to be the focus of acquisition. Wetland acquisition programs should be integrated with prairie and oak savanna acquisition programs, as these communities were originally highly interspersed with wetlands and have been the most severely reduced in acreage. Current public wetland acquisition efforts by the Department, the U.S. Fish and Wildlife Service, or other public agencies should be continued. The Natural Heritage Inventory is capable of identifying high-quality undisturbed wetlands which should be given protection from disturbance.

4. Better integration should occur among the goals and objectives of the many interests in wetland restoration and management involving Department programs such as Wildlife, Fisheries, Water Resources Management, Forestry, Environmental Analysis and Review, Water Regulations and Zoning, and Endangered Resources; federal agencies;

Despite this trend towards greater protection, wetlands will continue to be affected by agriculture, highway construction, commercial navigation, and urban/suburban development.

city and county governments; and the many private organizations contributing money and time, such as Ducks Unlimited, Wisconsin Waterfowl Association, and The Nature Conservancy. Ideally, wetland acquisition, protection, management, and restoration plans would be developed in partnership for each ecoregion of the state. A wetlands management plan has already been developed for Wisconsin as part of the North American Waterfowl Plan Joint Venture. This plan focuses primarily on waterfowl, but it is an excellent document with which to begin integrating other wetland protection needs.

5. Continued education and information programs are needed to develop increased public support and understanding of wetland protection and management activities. Wetland values, functions, and protection and management needs should be emphasized in primary and secondary environmental education curriculums. Public-attitude surveys should be conducted to assess knowledge of, use of, and interest in wetlands.

6. The current 20-year cycle for updating Department wetland inventory maps is inadequate for effective monitoring for state wetland protection and regulatory needs. A ten-year update cycle is desirable but will require additional staff and funding. The inventory mapping program should continue to be integrated with the Department's overall Geographic Information System program and the Department's proposed Aquatic and Terrestrial Inventory.

7. Wetland restoration, development, and enhancement projects should consider the full range of biodiversity concerns. Wetland restoration projects need to assess the biological aspects of restoring a wetland to its pre-altered state versus raising the water level above that which occurred before the wetland was altered. This analysis should take into account the type of wetland that will result from restoration alternatives, including the use of local genotypes, and resulting benefits to a wide variety of wildlife and plant life in a local area and region.

8. Riverine-floodplain wetlands along large rivers in the state should receive additional attention. These lowland and bottomland hardwood forest areas have diminished significantly in the state, and the remaining acreage of these types should receive additional protection. Studies should be conducted to assess the feasibility of restoring these lowland forest wetland types.

9. Coastal wetlands along Lake Michigan and Lake Superior have been severely reduced in acreage. The remaining wetlands should be protected from development through regulation or, if necessary, through easement or fee title acquisition.

10. The issue of mitigation will have to be addressed. Currently, the Department has authority to mitigate only for Department of Transportation highway projects. Pressures to apply mitigation for other types of development will likely increase. The Department must assess the scientific and public policy implications of mitigation to prevent the misuse of this concept, which can contribute to the decline of biodiversity of wetland communities.

11. Additional research should be conducted to understand the long-term effects of using wetlands for stormwater and wastewater disposal. Additional research is also needed to better understand how nutrients, heavy metals, and pesticides are cycled in wetland systems. There is also a need to continue to improve the Department's knowledge base on how to best achieve wetland restoration and management objectives for a wide variety of plant and animal species and communities.

Case Study

Restoring a Prairie Wetland Landscape in Southern Wisconsin

Contributed by Alan Crossley.

Land for Patrick Marsh Wildlife Area was transferred to the DNR by the Department of Transportation (DOT) in December 1991, creating the first wetland mitigation bank site in Wisconsin. The land was purchased by DOT to allow the restoration of a large wetland area known variously as "Patrick Lake," "Brazee Lake," "Brazee Swamp," "Duscheck's Marsh," "Phantom Lake," "The Old Lake," and more recently "Lake Sun Prairie." The goal of the project is to recreate a microcosm of what Patrick Marsh and the surrounding landscape looked like when William Patrick first came upon it in 1841—a large, thriving wetland community surrounded on the uplands by oak openings and tallgrass prairie.

The wetland restoration itself is different from most in that rarely do restorationists have a benchmark from which to evaluate the success or failure of the restoration, especially wetland restorations. Most of the time a wetland restoration merely attempts to restore the hydrology of a site, with no clear picture of what the wetland being restored looked like prior to drainage. Fortunately, we have lots of information about this site.

From the original land survey notes of Orson Lyon in 1834 to the reconstruction of the history of the marsh (beginning in 1841) by Effa Duscheck as part of her address to the Twentieth Century Club of Sun Prairie in 1925, much is known about the marsh. Because of its importance to Sun Prairie life, pictures dating back to the late 1800s show it in various stages of inundation and drawdown. Aerial photographs beginning in 1937 again give a picture of the changing character of this dynamic wetland. And Dr. Robert A. McCabe's study of the nesting ecology of water-obligate birds using the marsh from 1947 to 1951 describes bird use of the marsh and in particular notes the presence of the largest nesting colony of yellow-headed blackbirds in southern Wisconsin. His study also gives a glimpse into the species composition of the aquatic plant community.

The marsh was drained in 1965 after a court battle in which the DNR tried, unsuccessfully, to stop the drainage. But the recent expansion of State Trunk Highway 151 from two lanes to four lanes from Sun Prairie to Columbus set the stage for the cooperative restoration of the marsh as part of a wetland mitigation agreement between DOT and DNR.

Soon after DOT removed the pumping system in the winter of 1991-1992, the marsh began to fill with water. By April of 1992 there were close to 100 acres of water on the marsh with an average depth of about 18 inches and a maximum depth of about three feet. More than 5,000 ducks and 200 tundra swans were observed on the marsh during spring migration. Surveys that year found 13 species of breeding birds using the marsh itself and an additional 26 species using in the uplands. Twenty-eight different species of aquatic plants were already found in the marsh, just six months after it began to fill with water. A survey of frogs and toads found only the American toad present in the marsh.

Continued on next page

This 1937 air photo shows Patrick Marsh as it was—a shallow marsh and wet meadow that supported a wide diversity of plants and animals, including the largest breeding population of yellow-headed blackbirds in southern Wisconsin. *Photo from Agricultural Stabilization and Conservation Service.*

In 1991, when this photo was taken, the marsh was being drained and crops were being grown in it. The outline of the marsh, though, is still clear. *Photo from Agricultural Stabilization and Conservation Service.*

By the spring of 1993, the marsh filled to its normal level of about 160 acres of water with an average depth of almost five feet and a maximum depth of nearly eight feet. Sixteen species of breeding birds were found using the marsh and about the same number in the uplands. Aquatic plant diversity appeared to decrease slightly, perhaps as a result of the deepening water levels. But instead of hearing only the American toad, biologists heard six additional species of frogs. A graduate student working in the marsh found dozens of coot nests, as well as those of pied-billed grebe, sora rail, redhead, mallard, and blue-wing teal, to name a few. Several yellow-headed blackbirds returned to the marsh in 1993, although none were known to have nested.

In 1994, water levels in the marsh stabilized at their maximum level. Bird nest density seemed to be reduced, although nest success seemed to increase. At least two pairs of yellow-headed blackbirds probably nested on the marsh. Tiger salamanders were also caught at the marsh for the first time.

On the uplands, some progress has been made in restoring a few acres of prairie using locally collected native seed, thanks to funding support from DOT, lots of work by DNR wildlife managers, and great volunteer support from local citizens and Madison Audubon Society. During the winter of 1993-1994, many of the weedy tree species in the small wooded areas of the property were removed in favor of oaks and the native shrub understory.

Every day, one can see a car or two parked outside the gates as people walk along the road or stop to watch birds. A Sun Prairie middle school teacher has been working with DNR wildlife managers to use the marsh as an outdoor classroom. During spring and fall, small groups of students come out to the marsh for an hour or two at a time to learn about the wetland, its unique history, and the plants and animals that live in it. A Wisconsin Environmental Education Board grant is also being used to develop an education program at the marsh for Sun Prairie elementary, middle school, and high school classes.

[Top] The pumping system was removed in the winter of 1991–1992, and the marsh began to fill with water. By April 1992, when this photo was taken, there were almost 100 acres of water. More than 5,000 ducks and 200 tundra swans were observed during that spring's migration. *Photo from DNR files.*

[Bottom] By June 1993, when this photo was taken, the marsh was filled to its normal level of about 160 acres. Sixteen species of breeding birds were found using the same marsh, and about that same number were in the uplands. *Photo from DNR files.*

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